

Tic-Tac-Toe

Practice with Plotting Points

OVERVIEW

In this lesson, students practice plotting points by playing a game similar to tic-tac-toe. In this game, however, students play on a coordinate grid. Also, in order to win, they must get four Xs or Os in a row horizontally, vertically, or diagonally. While providing practice with plotting points, the game also encourages students to think strategically.

BACKGROUND

This graphing version of tic-tac-toe engages students' interest, making it an ideal activity for providing practice with plotting points on a coordinate grid and introducing or reinforcing the standard terminology of graphing. The game also promotes strategic thinking, giving a problem-solving aspect to practicing a skill.

When introducing the game, draw a small grid so that (5, 5) is the largest pair of coordinates that will locate a point that fits. This keeps the playing area small enough so that you can complete a game fairly quickly. When using a larger grid, such as an entire sheet of graph paper, some students, especially younger ones, mark their points far from their opponents' moves; the smaller playing area forces more interaction between the two teams' moves, pushing students to think strategically.

It makes sense in an introductory game for the teacher to mark the Xs and Os, modeling for the students how to use coordinates to locate points. However, after a first game, it's valuable to have students come up and mark the points they identify so that you can assess their ability to do so.

After the students are proficient with marking points, you may want to introduce them to plotting points that are below and to the left of the origin, when one or both of the coordinates are negative numbers. Learning about negative numbers isn't a focus in grades 3–5, but this version of tic-tac-toe provides a context for introducing the children to numbers less than zero. See this chapter's "Extensions" section for a suggestion about doing this.

While this lesson can be taught as a first experience with plotting points, it's also suitable as a follow-up to the lesson presented in Chapter 3, "Introduction to Coordinate Graphing." Check the "Background" section of that

chapter for additional information about graphing points on a coordinate grid. Also, to provide additional experience with plotting points, refer to Chapter 9, “Four Points: Investigating Patterns in Coordinates.”

VOCABULARY

axes, axis, coordinates, diagonal, horizontal, ordered pairs, origin, vertical

MATERIALS

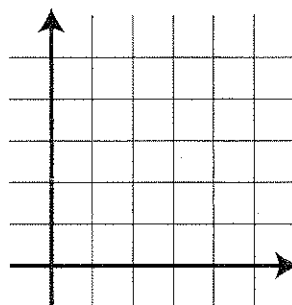
- *Tic-Tac-Toe* game grids, several per student (see Blackline Masters)
- optional: overhead transparency of *Tic-Tac-Toe* gameboard (see Blackline Masters)

TIME

- one class period to introduce, plus additional time for playing and describing strategies

The Lesson

To begin the lesson, I drew on the chalkboard a playing board as shown, ruling six vertical and six horizontal intersecting lines and marking the axes. (If you prefer, project an overhead transparency of the grid.)



I said to the class, “I’m going to teach you a game that’s like the game of tic-tac-toe that you all know how to play. One thing that’s different about this game is that we play on a grid like this. Another thing that’s different is that you put your X or O at the points where lines cross, not in the spaces as you do in regular tic-tac-toe. Also, in order to win this game, you must get four of your Xs or Os in a row, not three. Your four Xs or Os can be vertical, horizontal, or on a diagonal.” I motioned with my hand up and down when I said “vertical,” back and forth sideways when I said “horizontal,” and in both diagonal directions when I said “diagonal.” I then wrote on the board:

Seeing words helps some children more easily learn and remember terminology that may be new to them. Also, when they write about their strategies later, the words can be a useful reference.

I then said, "For a first game, I'm going to play against the class. I'll give you time before each of your turns to talk with your table group about what you think is a good next move. Also, choose someone who will report the move for your table. Then I'll call on a table, and the person you've chosen will tell me what point to mark. It's important to talk with your table group so that all of you know and agree on what you think is the best point to mark. You'll have fifteen seconds to decide. Do you have questions?"

"Only one table group gets to tell the turn for the whole class?" Beatriz asked.

"For this first game, that's correct," I said.

"Can we talk with other table groups?" Rick asked.

"No, you'll talk just with your own group," I explained.

"What if the table group you call on makes a mistake?" Annie asked.

"Hopefully that won't happen, since all members of the group will have discussed the move and agreed that it's a good one," I said. "Besides, typically there's more than one move that's a good play."

There were no more questions so I continued with instructions. "When you tell me what point to mark, you have to give me two numbers, and I'll use them as the coordinates to mark the point." I added *coordinates* to the list on the board. "It's important to talk with your table group so all of you know and agree on the coordinates for your move. Would you like to go first, or would you like to have me go first?"

"Us," the class said.

I responded, "OK, talk with your table group to figure out what you think would be a good move for your first turn. I'll time fifteen seconds." The class broke into excited discussion. Students usually get excited when playing this game, and I've found that the system I impose—for them to confer at their tables for fifteen seconds and then for me to call on one table for a move—is effective for managing the game. Having the students discuss moves at their tables keeps all students involved, and having table groups agree on moves avoids putting any one student on the spot. In some classes, I don't use fifteen-second time limits but instead call the class to order after I sense that they've had enough time to discuss. However, the extra structure is particularly useful when a class is a rambunctious group, like this one was. I timed the students for fifteen seconds using the second hand on the classroom clock. Then I called them to order and chose a table.

"Who is reporting for your table?" I asked.

"Oops," Kris said. "We didn't pick." I gave them a moment to do so.

"I'll do it," Karly announced.

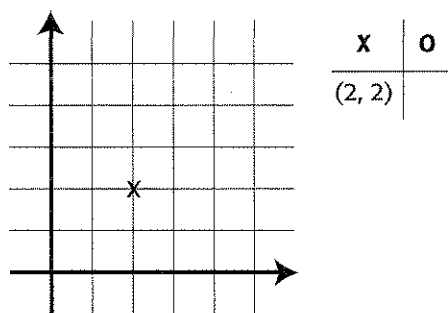
"What coordinates did your table choose?" I asked, using correct terminology to reinforce it.

"(Two, two)," Karly reported.

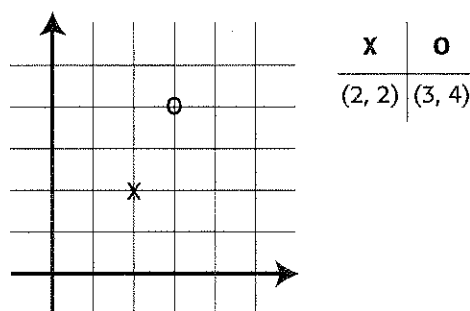
"Would you like to be X or O?" I asked.

"X," Karly replied. Before placing Karly's point, I recorded the coordinates. I ruled two columns on the board and labeled them X and O. Under the X, I wrote (2, 2). Then I located the point, saying as I did so, "I start at

the origin where the axes cross and count over to the right two and up two." As I had done before, I emphasized "over" and "up," and marked an X. Also, I added *origin* and *axes* to the list on the board.



I then said to the students, "Please time me for fifteen seconds." I waited until they reported that fifteen seconds had passed, then announced, "I'd like the point (three, four)." I wrote (3, 4) under the O, then placed the marker on the origin and moved it as I explained, "Starting at the origin, I count over to the right three and up four. I'm O, so that's where I'll put my O. Does everyone agree I'm in the right spot?" The students nodded.

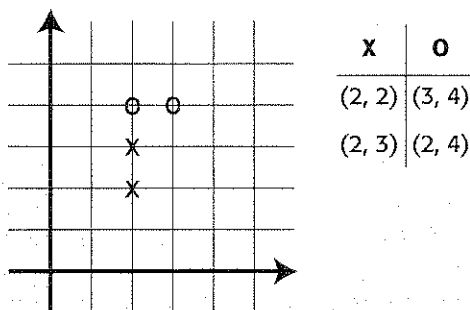


"Your turn. Fifteen seconds," I said. When time was up, I called on a different table.

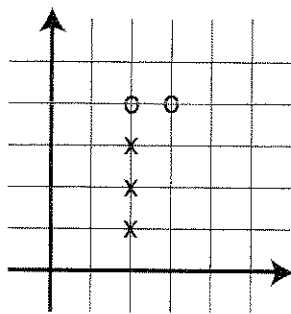
"We want (two, three)," Rick said, and his table partners gave him high fives to show their support and agreement. I wrote (2, 3) on the board under the X.

"Starting where the axes intersect, I count over on the horizontal axis to the right two and up three," I said, and marked the point with an X. I stopped to add *axis* to the list on the board, explaining, "Axis is singular. It means just one of the heavy number lines. We have two axes, a horizontal axis and a vertical axis."

The students then timed me for fifteen seconds. "I'll play at (two, four)," I said. I recorded the coordinates and marked an O.

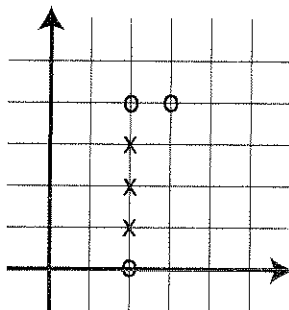


After I timed fifteen seconds, Nina announced her table's move. "(Two, one)," she said. I recorded the coordinates and marked an X.



X	O
(2, 2)	(3, 4)
(2, 3)	(2, 4)
(2, 1)	

After the class timed fifteen seconds, I said, "I guess I had better block. I'll play (two, zero)." I recorded the coordinates and marked my O, saying as I did so, "I had to play my O on the horizontal axis to block you."

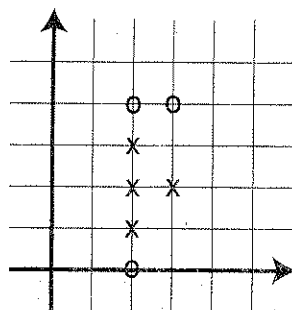


X	O
(2, 2)	(3, 4)
(2, 3)	(2, 4)
(2, 1)	(2, 0)

For their next move, Gary reported for his table and asked for (3, 2). Some students complained. I recorded the coordinates and pointed out, "(Three, two) is the reverse of (two, three) that you played before. The order of the coordinates matter. We also call them *ordered pairs*." I added *ordered pair* to the list of terminology.

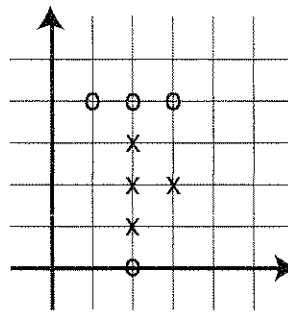
"You should have done (four, four) to block her," James said.

"No, this way we have Xs going in two ways," Sam defended his table's move. I placed the X for (3, 2).



X	O
(2, 2)	(3, 4)
(2, 3)	(2, 4)
(2, 1)	(2, 0)
(3, 2)	

I waited for them to call "time" and then said, "I'll play (one, four)." I recorded the ordered pair and marked the O.



X	O
(2, 2)	(3, 4)
(2, 3)	(2, 4)
(2, 1)	(2, 0)
(3, 2)	(1, 4)

"She blocked us," Jaime said.

"Yes," I confirmed. "You had two Xs going in a diagonal, so I played my O to block you." I timed fifteen seconds for them to talk about their next move.

James was looking at the board while his tablemates talked. "Now we're sunk!" James exclaimed. Others weren't as alarmed.

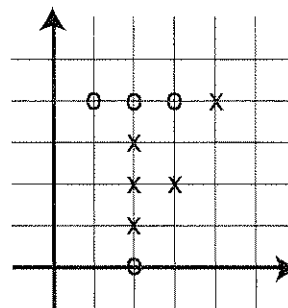
"We're sunk!" James said again.

"No, we can block her at (four, four)," Michael said.

"But that's not enough," Brianna said.

"Shh, let's not tell her more," Cami said in a loud whisper.

"Decide at your tables where you'd like to move next," I said. I timed fifteen seconds and then called on a table. Armando said, "(Four, four)," as Michael had suggested.



X	O
(2, 2)	(3, 4)
(2, 3)	(2, 4)
(2, 1)	(2, 0)
(3, 2)	(1, 4)
(4, 4)	

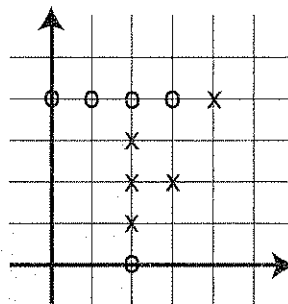
"Look, we blocked her!" Rick said.

"I tell you, we're sunk!" James said once more.

"I'll play (zero, four)," I said after the class had timed fifteen seconds. I recorded the coordinates and placed my O.

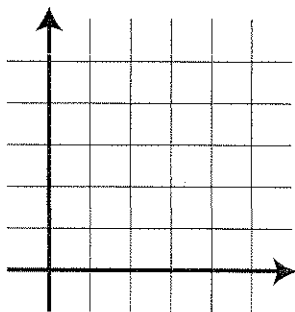
"You win," Annie said.

"Yes, I have four in a row horizontally," I said.



X	O
(2, 2)	(3, 4)
(2, 3)	(2, 4)
(2, 1)	(2, 0)
(3, 2)	(1, 4)
(4, 4)	(0, 4)

Playing a Second Game “Would you like to play again?” I asked. There was a resounding “Yes!” I erased the game, redrew a grid, and marked the axes.



“This time, I’ll divide the class into two teams so that the tables on the right side of the room play against the tables on the left side.” I identified the tables for each team.

I explained, “As you did before, you’ll talk at your tables for fifteen seconds about the move you’d like to make. I’ll call first on a table group from the right side of the room, then one from the left side.”

I erased the coordinates I had listed in two columns and said, “For this game, I’d like one person from each team to come up and record the coordinates for each of your team’s turns. Who would like to do this?” There were several volunteers and I chose Nina for the X team and Gary for the O team. Having students record the coordinates helps establish a way that the class can play the game independently. Also, the students who record benefit from the practice of writing ordered pairs.

I gave the tables time to discuss possible moves. After fifteen seconds, I said to Nina, “Call on a table from your team.”

Nina identified a table and Cami gave the coordinates. “We think (three, three),” she said. Nina wrote 3, 3 on the board under the X. I reminded her, “We always put parentheses around coordinates and separate the two numbers with a comma.” Nina made the correction.

Instead of locating the X myself, I held the marker out to Cami and said, “Come up and mark your X.” It’s important to have the students come up to plot points. It not only helps them be more actively involved, but also gives me a way to check on their understanding of the skill.

As Cami came up to the overhead projector, I said, “Please count out loud and show how you’re plotting the point.” Cami put the marker at the origin, counted over three and up three, and marked an X.

I again timed fifteen seconds and then asked Gary to choose a table. Jaime reported. “(Four, three),” he called out confidently. Gary recorded the pair and Jaime came up to place the O.

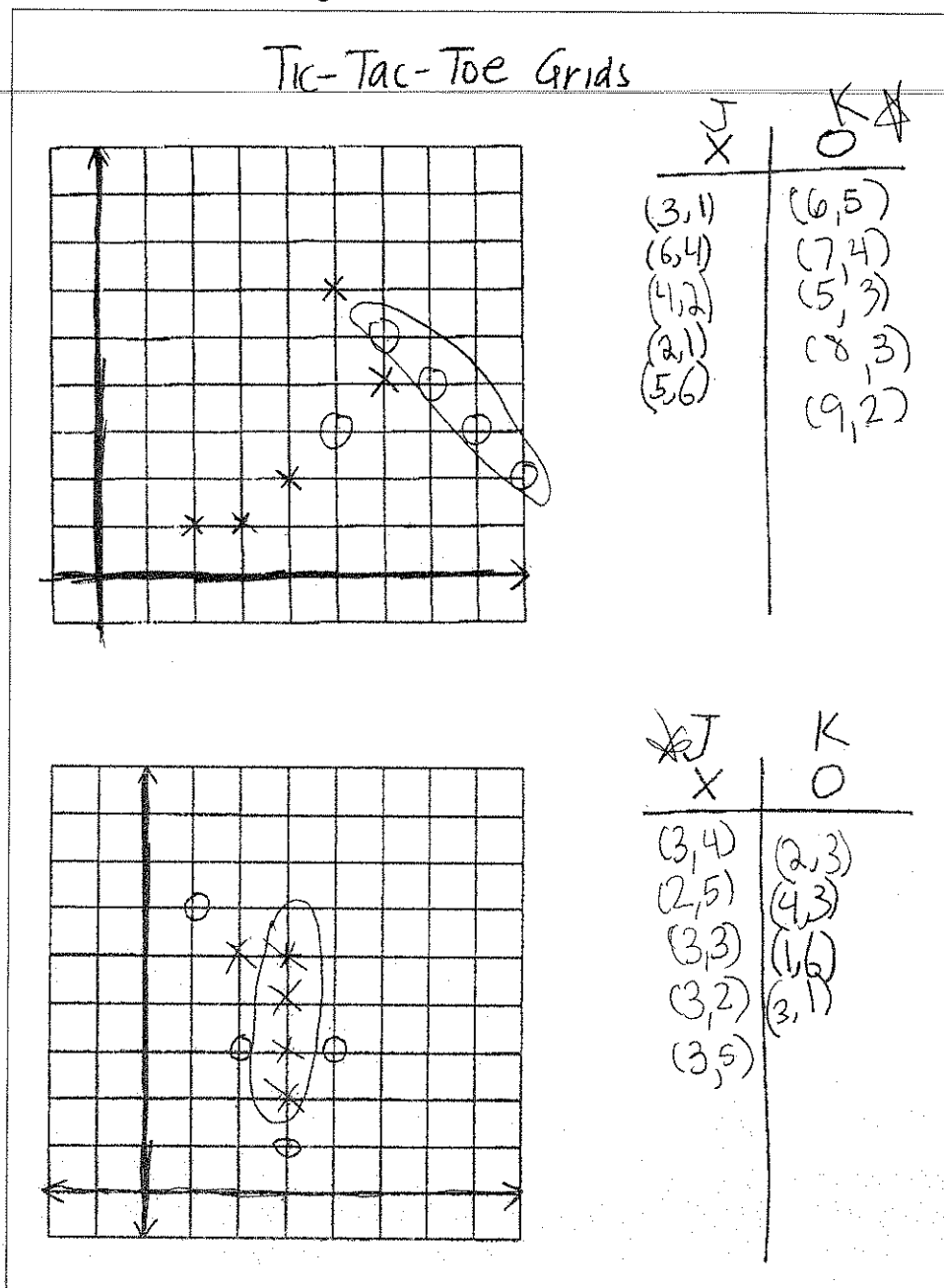
Play continued in this way. A few of the students had difficulty placing their point, still needing practice. The most common error was to start counting before they moved to the right or up, forgetting that the point on the axis was 0, not 1. But I’ve learned that with practice, students soon stop making this error and become proficient with plotting points.

We had time for one more game before class time ran out. Over the next few days, we played a game each day until I felt sure that all of the students

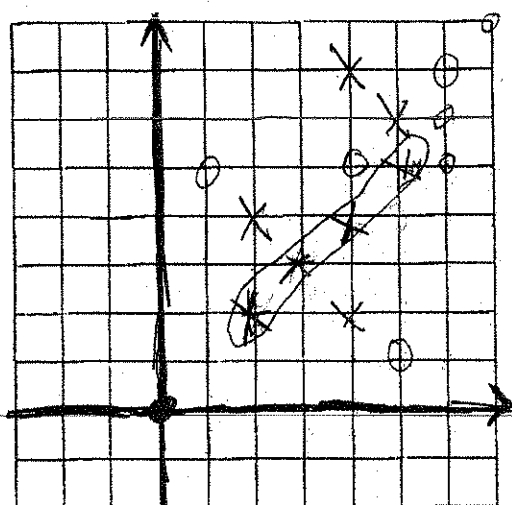
could use coordinates to plot points correctly and with confidence. Also, I transferred the words from the board to chart paper to post for their reference.

Playing in Pairs Playing *Tic-Tac-Toe* then became an option for choice time for students to play in pairs. I duplicated *Tic-Tac-Toe* grids, two on a page. These grids were larger than I had used for the whole-class games and gave students more playing room. When they played, they first had to draw the axes. They also had to keep track of their moves, as we had done on the board. However, when playing in pairs, the students didn't have to use the fifteen-second rule. Interest in the game continued for several weeks. Figures 4-1 and 4-2 show two pairs' games.

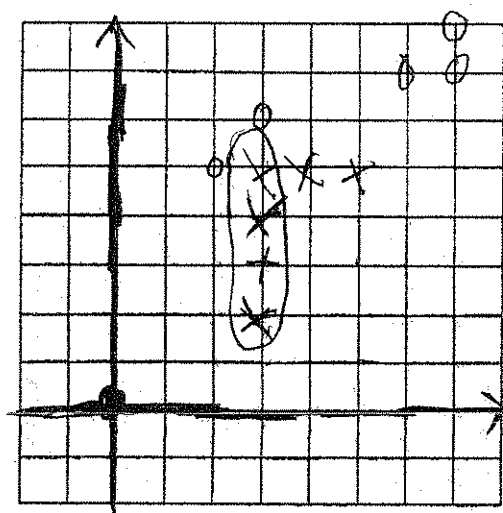
FIGURE 4-1 Kris won the first game with four Os on a diagonal, and Jaime won the second game with four vertical Xs.



Tic-Tac-Toe Grids



X	O
(3,3)	(7,8)
(4,2)	(6,7)
(2,4)	(5,1)
(5,6)	(1,5)
(4,7)	(4,5)
(5,5)	(6,5)
(4,4)	(6,6)
(2,2)	



X	O
(3,3)	(7,8)
(3,5)	(6,7)
(5,5)	(7,1)
(4,5)	(3,6)
(3,7)	(2,5)
(3,2)	

Extensions

1. After students have played for a while, ask them to write about the strategies they use when playing the game. Encourage them to use as many words as possible from the list posted. For example, Luis wrote: *My strategy is that I think it's easier to go diagonal because I won all the games using diagonal strategies. All my coordinates were close. I kept them in a group.* Lisa wrote: *I started with a right angle with my X's. I could go diangle, horizontal, and*

vertical. If he blocked me one way I could move the next. (See Figure 4-3.) Sam wrote: A good strategy could be to go in the center of the box. Then you could go vertical, diagonal, and horizontal. Figures 4-4 through 4-7 show other students' strategies.

FIGURE 4-3 Lisa explained her strategy of placing three Xs to make a right angle.

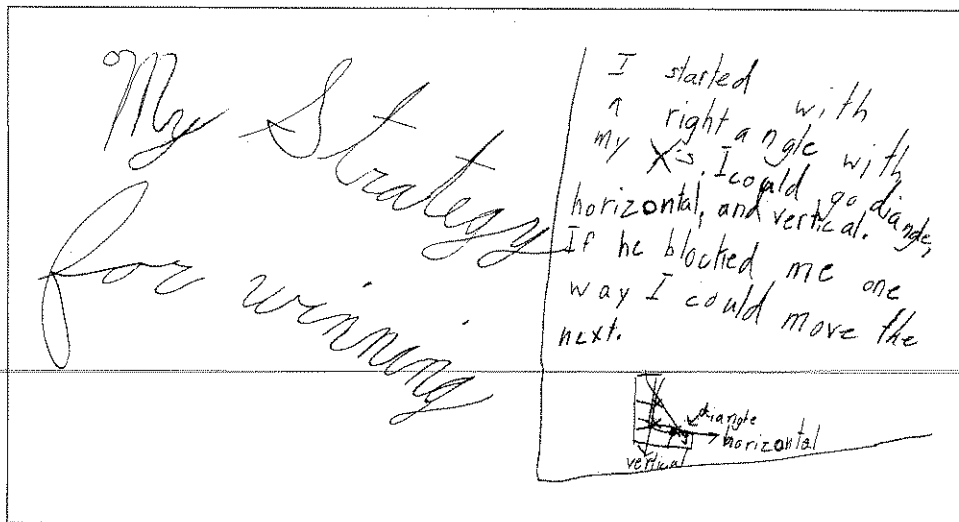
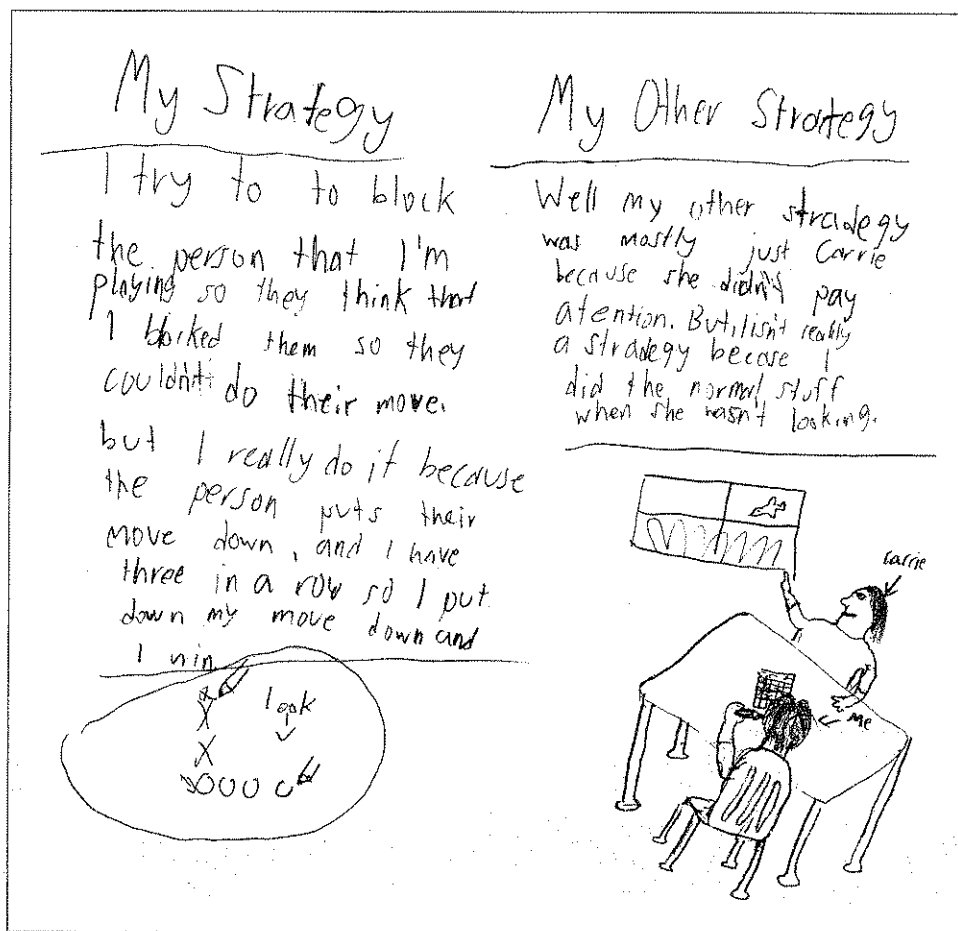


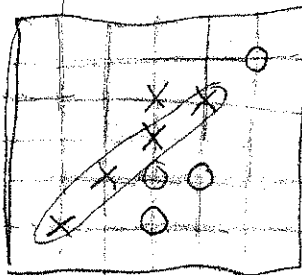
FIGURE 4-4 Shea explained the two strategies that he used and included a drawing to illustrate his second idea.



HERE ARE SOME STRATEGIES I LEARNED:

① My favorite strategy is one that will confuse the opponent. It is when you put all your "moves" in a cluster. Then your opponent takes their turn and thinks they're blocked.

Example:
you, but they haven't.



② My second strategy is one in which you pretend you are blocking your opponent.

but you are really winning yourself!

Example:

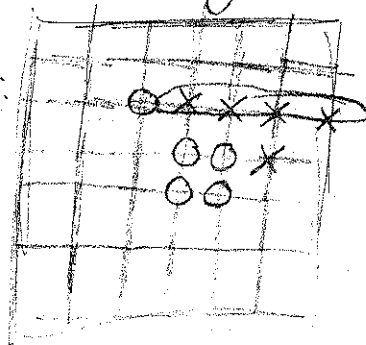


FIGURE 4-6

In his strategies, Eli tried to use all of the words from the vocabulary list.

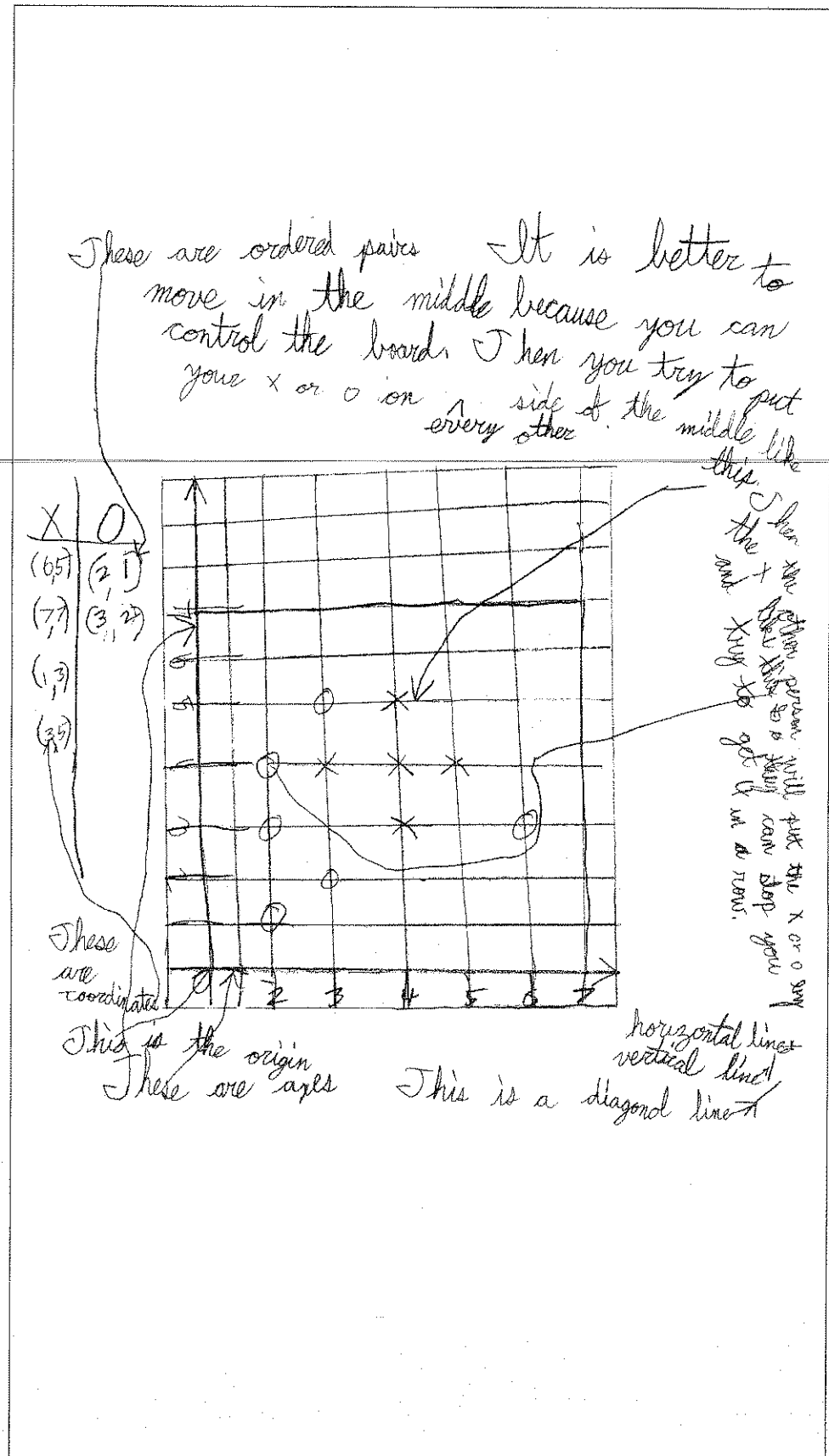
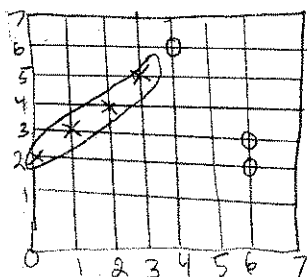


FIGURE 4-7 Katia's strategy was to place three Xs or Os in a diagonal row with two open spaces on both sides.

My Strategies

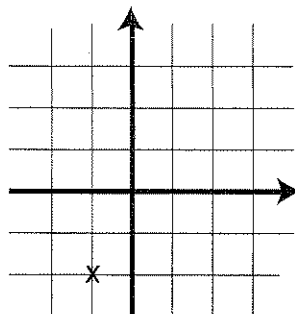
My strategy is you make 3 O's or X's going diagonally with two spaces on both sides then if your opponent goes on one side the you go on the other you win! That is what my strategies mathematics tic-tac-toe.



X	O
(2,4)	(6,2)
(3,5)	(4,3)
(1,3)	(4,6)
(0,2)	

2. For a homework assignment, ask students to play the game with someone at home.

3. Introduce students to plotting points below and to the left of the origin by redefining the playing area for a game of *Tic-Tac-Toe* to include more than just the upper right quadrant. Mark an X as shown:



Ask students what the ordered pair might be to locate the point you marked. You may want to refer to a thermometer as a model of a number line that has numbers below zero. Typically, some student in the class comes up with a suggestion, and often the suggestion is to use a “minus” number. The thinking is correct, but the correct terminology for numbers less than zero is *negative numbers*. The coordinates for the point shown above are $(-1, -2)$, read as “negative one, negative two.” If no student suggests these coordinates, then it’s appropriate to explain this mathematical convention by introducing the language, showing how to write the numbers, and modeling how to use negative numbers to plot points. Some students will choose to use negative numbers in their own games. (See Figure 4–8 [below] and Figure 4–9 on the following page.)

FIGURE 4–8 Torin and Emma used both positive and negative coordinates in their game.

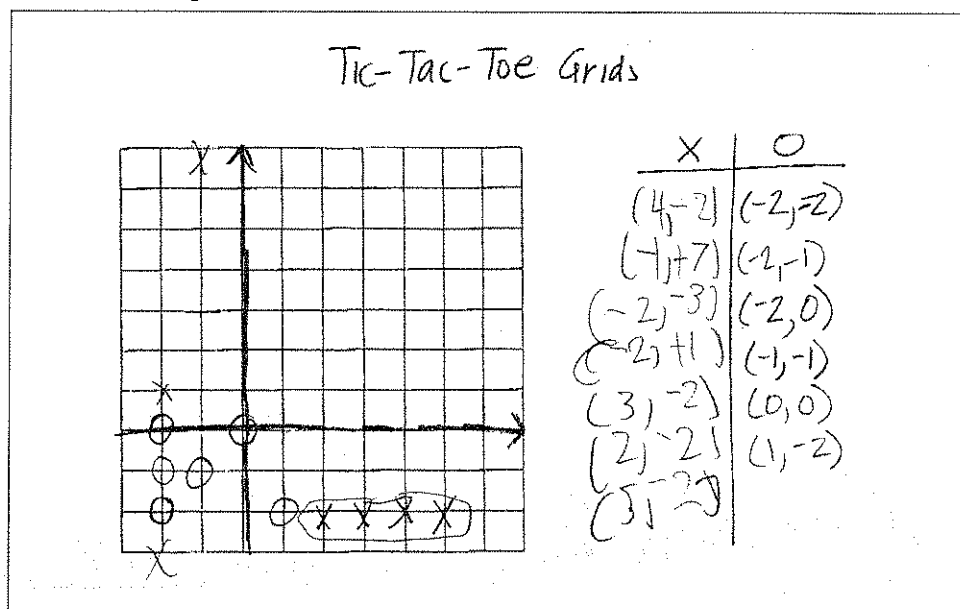
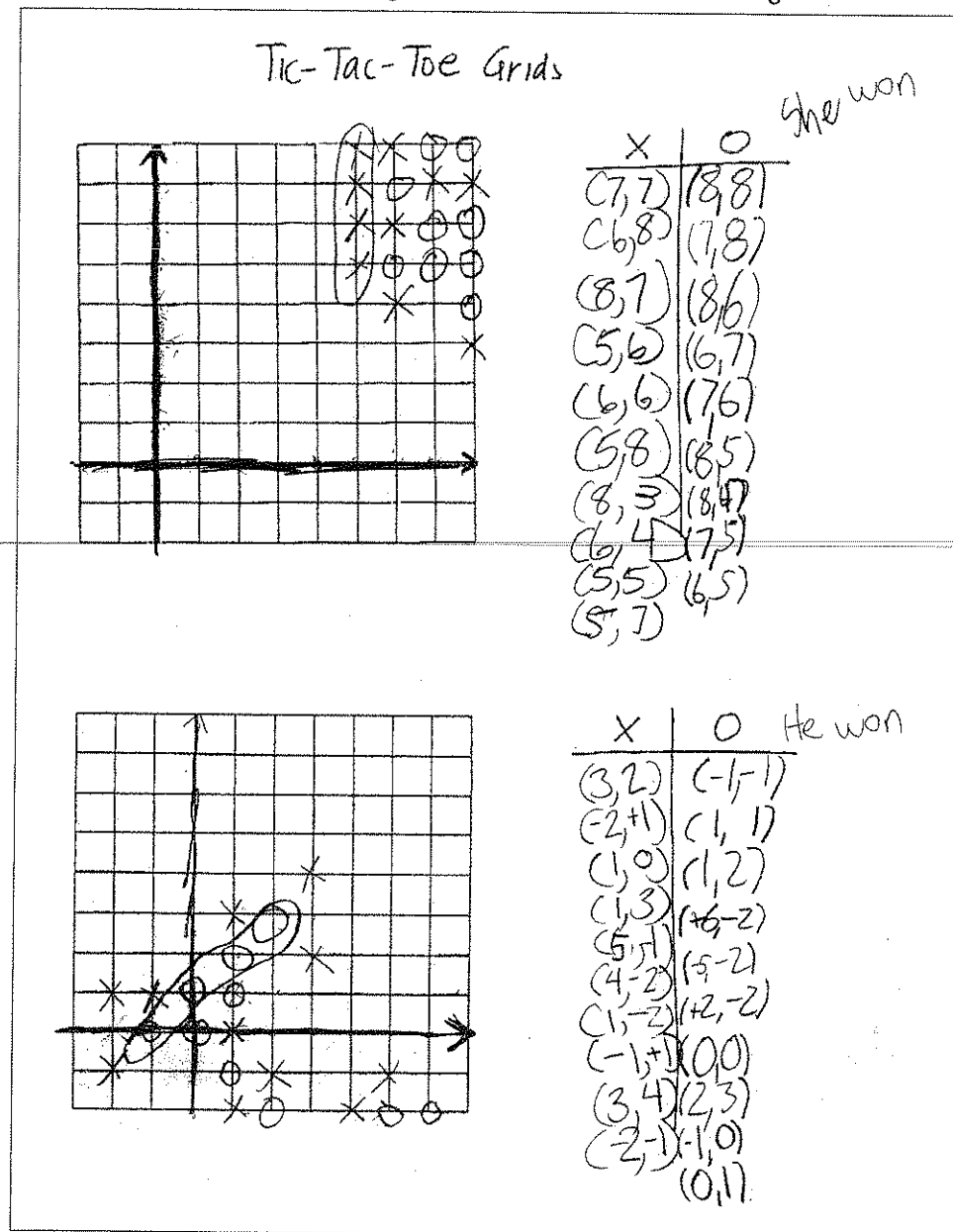


FIGURE 4-9 Karly and Armando used only positive coordinates in their first game but then used negative coordinates in their second game.



4. One day, Amy, James, and Sam asked if they could play together. I agreed, and they used Xs, Os, and Ss. (Sam used the Ss.) Figure 4-10 on page 70 shows two of their games.

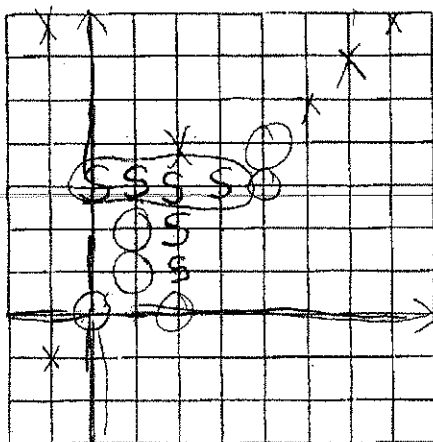
Others tried playing in groups of three as well. “You have a longer game that way,” Rick said.

“And it’s easier to sneak a move that your opponent doesn’t notice,” Armando said.

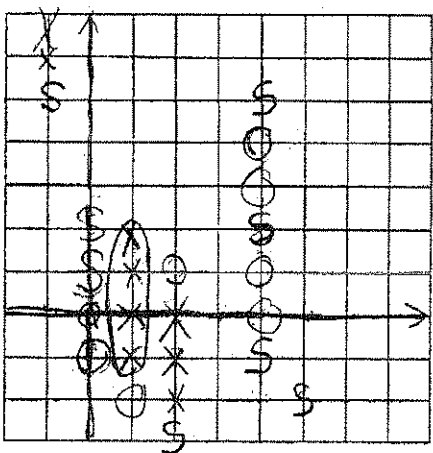
FIGURE 4-10

When Amy (X), James (O), and Sam (S) played together, Sam won the first game and Amy won the second game. They used negative coordinates in both games.

Tic-Tac-Toe Grids



X	O	S
(6,6)	(0,0)	(3,3)
(-1,7)	(1,1)	(2,2)
(5,5)	(1,2)	(2,1)
(7,7)	(4,4)	(2,3)
(2,4)	(2,0)	(1,3)
(-1,7)	(4,3)	(0,3)



X	O	S
(-1,7)	(4,3)	(4,2)
(1,1)	(4,4)	(4,5)
(-1,6)	(4,1)	(1-5+)
(2,-2)	(0,0)	(4,1-)
(2,0)	(1,2)	(5,2-)
(2,-1)	(-1,1)	(0,2)
(1,-1)	(2,1)	(2,-3)
(1,0)	(4,0)	(0,1)
(1,2)		